PATENT ABSTRACTS OF JAPAN

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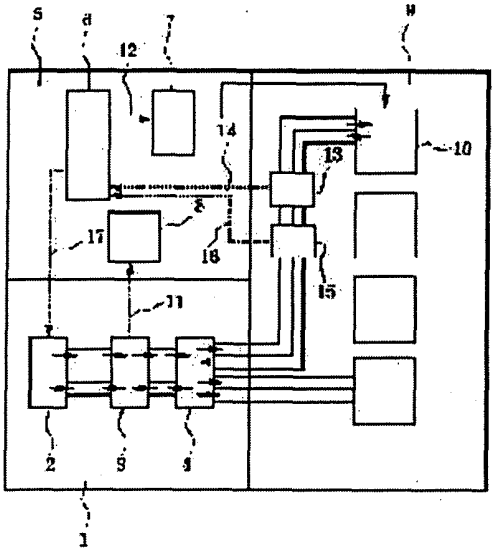
(54) ALIGNER AND MANUFACTURE OF DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To surely recover a substrate, even when cooling water fed to a region other than a stage becomes abnormal in flow rate, to cope with heat released from an actuator even when cooling water is decreased in a flow rate to a certain extent, and to restrain a stage from being driven as runaway even when cooling water becomes abnormal in flow rate, while the stage is driven.
SOLUTION: Cooling state detecting means 13 and 15, which detect the cooling state of the actuator of an exposure system and a drive control means 5 which controls the drive of the actuator based on the detection result of a cooling state, are provided. The cooling state detecting means 13 and 15 detect the flow rate and/or the temperature of cooling water fed to the actuator of the stage 10, and the drive control means allows or forbids the stage 10 independently to be driven or controls the acceleration of the stage 10 based on the detection result, and furthermore forbids the stage 10 to be driven after it is decelerated as prescribed, when the stage 10 is forbidden to be driven while the stage is driven. Furthermore, the actuator is controlled in cooling state based on the detection result of a cooling state.



LEGAL STATUS

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CLAIMS

[Claim(s)]
[Claim 1] The aligner characterized by providing a cooling situation detection means to detect the cooling situation of the actuator which equipment has, and the drive control means which control the drive of the aforementioned actuator based on the detection result of the aforementioned cooling situation.
[Claim 2] The aforementioned actuator is an actuator which drives the stage for positioning the substrate by which the negative or the aforementioned exposure pattern which has an exposure pattern is exposed, and is what is cooled with cooling water. It is the aligner according to claim 1 which the aforementioned cooling situation detection means detects the flow rate of the cooling water to the aforementioned actuator, and is characterized by the aforementioned drive control means being that to which other portions make the drive of the aforementioned stage permission and a prohibition state independently based on the detection result of the aforementioned flow rate.
[Claim 3] The aforementioned actuator is an actuator which drives the stage for positioning the substrate by which the negative or the aforementioned exposure pattern which has an exposure pattern is exposed, and is what is cooled with cooling water. It is the aligner according to claim 1 which the aforementioned cooling situation detection means detects the temperature of the cooling water to the aforementioned actuator, and is characterized by the aforementioned drive control means being that to which other portions make the drive of the aforementioned stage permission and a prohibition state independently based on the detection result of the aforementioned temperature.
[Claim 4] The aforementioned actuator is an actuator which drives the stage for positioning the substrate by which the negative or the aforementioned exposure pattern which has an exposure pattern is exposed, and is what is cooled with cooling water. The aforementioned cooling situation detection means is what detects the flow rate and temperature of cooling water to the aforementioned actuator. The aforementioned drive control means are aligners according to claim 1 characterized by being that to which other portions make the drive of the aforementioned stage permission and a prohibition state independently based on the detection result of the aforementioned flow rate and temperature.
[Claim 5] It is the aligner according to claim 1 the aforementioned actuator is the actuator which drives the stage for positioning the substrate by which the negative or the aforementioned exposure pattern which has an exposure pattern is exposed, it is cooled with cooling water, and the aforementioned cooling situation detection means detects the flow rate of the cooling water to the aforementioned actuator, and carry out that the aforementioned drive control means are what controls in the acceleration of the aforementioned stage based on the detection result of the aforementioned flow rate as the feature.
[Claim 6] It is the aligner according to claim 1 the aforementioned actuator is an actuator which drives the stage for positioning the substrate by which the negative or the aforementioned exposure pattern which has an exposure pattern is exposed, it is cooled with cooling water, and the aforementioned cooling situation detection means detects the temperature of the cooling water to the aforementioned actuator, and carry out that the aforementioned drive control means are what controls in the acceleration of the aforementioned stage based on the detection result of the aforementioned temperature as the

feature.
[Claim 7] It is the aligner according to claim 1 the aforementioned actuator is the actuator which drives the stage for positioning the substrate by which the negative or the aforementioned exposure pattern which has an exposure pattern is exposed, it is cooled with cooling water, and the aforementioned cooling situation detection means detects the flow rate and the temperature of cooling water to the aforementioned actuator, and carry out that the aforementioned drive control means are what controls in the acceleration of the aforementioned stage based on the detection result of the aforementioned flow rate and temperature as the feature.
[Claim 8] The aforementioned drive control means are aligners given in any 1 term of the claims 2-4 characterized by being what makes the drive of the aforementioned stage a prohibition state since the aforementioned stage is decelerated with the same acceleration as the time of acceleration and is stopped when making the drive of the aforementioned stage into a prohibition state, while the aforementioned stage is driving.
[Claim 9] The aligner characterized by providing a cooling situation detection means to detect the cooling situation of the actuator which equipment has, and a cooling situational-control means to control the cooling situation of the aforementioned actuator based on the detection result of the aforementioned cooling situation.
[Claim 10] It is the aligner according to claim 9 carry out that the aforementioned actuator is the actuator which drives the stage for positioning the substrate by which the negative or the aforementioned exposure pattern which has an exposure pattern is exposed, and it is what it is cooled with cooling water, the aforementioned cooling situation detection means detects the flow rate or the temperature of cooling water to the aforementioned actuator, and the aforementioned cooling situational-control means determines the temperature of the cooling water to the aforementioned actuator, and changes as the feature.
[Claim 11] The device manufacture method characterized by manufacturing a device by exposing using an aligner, controlling the drive of the aforementioned actuator based on the cooling situation of the actuator.
[Claim 12] The device manufacture method according to claim 11 characterized by manufacturing a device by exposing controlling the cooling situation of the aforementioned actuator based on the cooling situation of the aforementioned actuator.
[Claim 13] The aforementioned actuator is an actuator which drives the stage for positioning the substrate by which the negative or the aforementioned exposure pattern which has an exposure pattern is exposed, and is what is cooled with cooling water. The aforementioned cooling situation is the device manufacture method according to claim 11 or 12 characterized by being the flow rate of the aforementioned cooling water, or the situation of temperature, facing control of a drive of the aforementioned actuator, and permitting and forbidding the drive of the aforementioned stage independently of other portions, or specifying acceleration.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the device manufacture method that the aligner and this which use cooling water etc. for cooling of the actuators for a stage drive etc. can be used.
[0002]
[Description of the Prior Art] Drawing 5 shows the composition about the stage drive system of the conventional semiconductor aligner, and cooling. In the machine room 1 of a semiconductor aligner, the chiller 2, the amount detection means 3 of circulating water flows, and the cooling water distributor 4 are constituted. In the control unit 5 of a semiconductor aligner, the main part power control machine 8 of equipment is constituted with the stage drive controller 6 and the driver 7 for a stage drive. The stage unit 10 is constituted in the main part 9 of a semiconductor aligner.
[0003] A chiller 2 cools the warmed cooling water which has returned from each unit in a main part 9, and makes the cooling water of constant temperature again. The amount detection means 3 of circulating water flows always detects the flow rate of cooling water, and if it becomes below the set point with a flow rate, it will send the amount of circulating water flows unusual signal 11 to the main part power control machine 8 of equipment in the control rack 5. The cooling water distributor 4 arranges the cooling water which comes from the amount detection means 3 of circulating water flows by each YUNITTOHE in a main part 9. The stage drive controller 6 is a controller for carrying out drive control of the stage unit 10. The driver 7 for a stage drive supplies the current into which the current instructions 12 were inputted from the stage drive controller 6 and which was ordered from it to each linear motor in the stage unit 10 (X, YL, YR), and drives a stage. The main part power control machine 8 of equipment turns off the main part power supply of equipment, if the amount of circulating water flows unusual signal from the amount detection means 3 of circulating water flows is inputted.
[0004]
[Problem(s) to be Solved by the Invention] However, in the above-mentioned conventional example, when the amounts of circulating water flows of units other than stage unit 10 are abnormalities, although the amount of circulating water flows of stage unit 10 HE is normal, the amount of circulating water flows unusual signal occurs from the amount detection means 3 of circulating water flows, and the main part power supply of equipment is set to being turned off. Consequently, the power supply of a stage drive system may also be set to being turned off, and recovery of a wafer etc. may become impossible. Thereby, there is a fault that the availability of equipment will fall.
[0005] Moreover, if the amount of circulating water flows unusual signal occurs while the stage is driving by constant speed, since the power supply of a stage drive system is also turned off, a stage cannot be slowed down and there is a fault that there is a possibility that a stage may overrun recklessly.
[0006] In view of the trouble of such conventional technology, in an aligner and the device manufacture method, even when the flow rates of cooling water other than a stage are abnormalities, the 1st purpose of this invention avoids the situation of recovery of a wafer etc. becoming impossible, and is to raise

equipment availability by this.
[0007] The 2nd purpose of this invention is to raise an equipment operating ratio also to the fall of the flow rate of a certain amount of cooling water, as it can respond to generation of heat of an actuator.
[0008] The 3rd purpose of this invention is to make it the overrun of a stage not take place, even if the flow rate of cooling water becomes unusual, while the stage is driving by constant speed.
[0009]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, the aligner of this invention is characterized by providing a cooling situation detection means to detect the cooling situation of the actuator which equipment has, and the drive control means which control the drive of an actuator based on the detection result of a cooling situation.
[0010] Moreover, the device manufacture method of this invention is characterized by manufacturing a device by exposing using such an aligner, controlling the drive of an actuator based on the cooling situation of the actuator.
[0011] According to this, even when a cooling situation gets worse by the fall of the flow rate of a certain amount of cooling water etc., generation of heat of an actuator is suppressed by suppressing the driving force of an actuator etc.
[0012] Moreover, the aligner concerning another gestalt of this invention is characterized by providing a cooling situation detection means to detect the cooling situation of the actuator which equipment has, and a cooling situational-control means to control the cooling situation of the aforementioned actuator based on the detection result of the aforementioned cooling situation. A cooling situational-control means controls the cooling situation of an actuator by determining the temperature of the cooling water to an actuator, and changing.
[0013] According to this, with a chisel, such as suppressing the driving force of an actuator, even when generation of heat of an actuator cannot be suppressed, in addition to suppression of the driving force of an actuator, generation of heat of an actuator is suppressed by lowering the setting temperature of cooling water etc., and improvement in the depressor effect of generation of heat of an actuator is achieved.
[0014]
[Embodiments of the Invention] In the desirable operation gestalt of this invention, an actuator is an actuator which drives the stage for positioning the substrate by which the negative or exposure pattern which has an exposure pattern is exposed, and is cooled with cooling water. A cooling situation detection means detects the flow rate and/or temperature of cooling water to an actuator. Drive control means make the drive of a stage permission and a prohibition state independently with other portions based on the detection result of the aforementioned flow rate and/or temperature. If the flow rate and/or temperature of cooling water to a stage are in tolerance even when the flow rates and/or temperature of cooling water to units other than a stage are abnormalities according to this, since the drive of a stage can perform recovery of a substrate etc., without stopping, improvement in equipment availability will be achieved.
[0015] Moreover, drive control means control the acceleration of the aforementioned stage based on the detection result of the flow rate by the aforementioned cooling situation detection means, and/or temperature. According to this, it can respond by lowering the acceleration at the time of the acceleration and deceleration of a stage, and reducing generation of heat of an actuator to the fall of the flow rate of a certain amount of cooling water, and/or temperature. Therefore, it leads to the rise of an equipment operating ratio.
[0016] Moreover, since drive control means decelerate a stage with the same acceleration as the time of acceleration and stop it when making the drive of a stage into a prohibition state, while the stage is driving, they make the drive of a stage a prohibition state. The overrun of a stage is prevented, even when abnormalities occur to the flow rate and temperature of cooling water according to this, while the stage is driving.
[0017]
[Example] (The 1st example) Drawing 1 is drawing showing the aligner concerning the 1st example of

this invention, and is drawing which expresses the feature of this invention best. In this drawing, 1-12 point to the same element as the case of the conventional example of drawing 5 . 13 is an amount detection means of stage circulating water flows to detect the amount of stage circulating water flows for linear motor cooling for a stage drive of the stage unit 10, and 14 is the amount information of stage circulating water flows sent to the stage drive controller 6 from the amount detection means 13 of stage circulating water flows.

[0018] In the above-mentioned composition, the amount detection means 13 of stage circulating water flows detects the flow rate of the cooling water of the linear motor for a stage drive distributed to the stage units 10 from the cooling water distributor 4. The detected amount information 14 of stage circulating water flows is sent to the stage drive controller 6. Based on the amount information 14 of stage circulating water flows, if the stage drive controller 6 has the normal flow rate of the cooling water to the stage unit 10, it will not stop the drive of the stage unit 10. Thereby, if the flow rate of the cooling water to the stage unit 10 is normal even when the amounts of circulating water flows of units other than stage unit 10 are abnormalities, since it does not stop, the drive of the stage unit 10 will be completed normally, can carry out the thing of the recovery of a wafer etc., and can raise the availability of equipment.

[0019] (The 2nd example) Drawing 2 is drawing explaining the 2nd example of this invention, and is drawing which explains a stage acceleration determination means to determine the acceleration of the acceleration and deceleration of the stage drive in the stage unit 10, from the amount value of circulating water flows acquired by the amount detection means 13 of stage circulating water flows. The block diagram of the whole equipment is the same drawing 1 as the case of the 1st example. This stage acceleration determination means exists in the stage drive controller 6.

[0020] In drawing 2 , 21 is a line which shows a stage drive pattern in case the amount of circulating water flows to the linear motor of the stage in the stage unit 10 is usual, and 22 is a line which shows a stage drive pattern in case the amount of linear motor circulating water flows of a stage has only 90 usual%. Thus, when the amount of linear motor circulating water flows has only 90 usual%, in order to suppress generation of heat from a part and a linear motor to which the amount of linear motor circulating water flows decreased 10%, acceleration at the time of the acceleration and deceleration of a stage is made small.

[0021] 23 shows a stage drive pattern in case the amount of linear motor circulating water flows of a stage has only 80 usual%. in this case, the amount of linear motor circulating water flows -- 20% **** -- in order to suppress generation of heat from a part and a linear motor the bottom, acceleration at the time of the acceleration and deceleration of a stage is made still smaller than the case of a line 22

[0022] Since it becomes impossible to suppress generation of heat from a linear motor depending on making small acceleration at the time of stage acceleration and deceleration when the amount of linear motor circulating water flows becomes 70 usual% or less, a stage is changed into the state of the ban on a drive. It is because the air temperature around a stage will rise and the measurement error of a laser interferometer not only occurs, but it will lead to damage on a linear motor, if it leaves as it is without cooling generation of heat from a linear motor.

[0023] Since it can respond by making calorific value from a linear motor small to some amount reduction of circulating water flows by this, an equipment operating ratio rises conventionally.

[0024] (The 3rd example) Drawing 3 is drawing explaining the 3rd example of this invention, and since it decelerates a stage with the same acceleration as the time of stage drive acceleration and stops a stage when considering as a stage drive prohibition state while the stage is driving by constant speed as the 2nd example showed, it is a flow chart which shows operation of the stage emergency shut down means which confirms the aforementioned stage drive prohibition state. The block diagram of the whole equipment is the same drawing 1 as the 1st example. This stage emergency shut down means exists in the stage drive controller 6.

[0025] The amount of stage circulating water flows becomes 70 usual% or less, and since it becomes impossible to correspond only by adjusting the acceleration at the time of stage acceleration and deceleration, a stage drive prohibition command signal judges under a drive of a stage and a halt (Step

15) and now [****** and] (Step 16), and if a stage becomes during a halt, it will go into a stage drive prohibition state as it is (Step 19). If a stage becomes during a drive, a stage will be decelerated with the same acceleration as the time of stage acceleration, and a stage will be stopped (Step 17). And it waits until it stops, if it judges whether the stage stopped or not (Step 18) and the stage has not stopped. If a stage stops, it goes into a stage drive prohibition state (Step 19), and it will operate so that a stage cannot be driven until the amount of stage circulating water flows becomes normal and a drive prohibition state is canceled. The overrun of a stage can be prevented, even if the amount of circulating water flows unusual signal occurs by this, while the stage is driving by constant speed.

[0026] (The 4th example) Drawing 4 is the block diagram showing the composition of the whole semiconductor aligner concerning the 4th example of this invention. In this drawing, 1-14 are the same as that of the case of the 1st example. 15 is a stage circulating-water-temperature detection means to detect the stage circulating water temperature for linear motor cooling for a stage drive in the stage unit 10, 16 is the information on the stage circulating water temperature sent to the stage drive controller 6 from the stage circulating-water-temperature detection means 15, and 17 is cooling water setting temperature instructions sent to a chiller 2 from the stage drive controller 6.

[0027] In the above-mentioned composition, the amount detection means 13 of stage circulating water flows detects the flow rate of the cooling water of the linear motor for a stage drive distributed to the stage units 10 from the cooling water distributor 4. The information 14 on the detected amount of stage circulating water flows is sent to the stage drive controller 6. The stage circulating-water-temperature detection means 15 detects the temperature of the cooling water of the linear motor for a stage drive distributed to the stage units 10 from the cooling water distributor 4. The information 16 on the detected stage circulating water temperature is sent to the stage drive controller 6.

[0028] The acceleration of the acceleration and deceleration of a stage drive is determined from the amount information 14 of stage circulating water flows acquired from the amount detection means 13 of stage circulating water flows, and the stage circulating-water-temperature information 16 acquired from the stage circulating-water-temperature detection means 15. A stage acceleration determination means to make this decision exists in the stage drive controller 6.

[0029] A stage acceleration determination means makes small acceleration at the time of the acceleration and deceleration of a stage, in order to suppress generation of heat of the linear motor equivalent to the refrigeration capacity fall of the part to which the flow rate decreased, when the flow rate of linear motor cooling water decreases. Moreover, when the temperature of linear motor cooling water rises, in order to suppress generation of heat of the linear motor equivalent to the refrigeration capacity fall of a part which carried out the temperature rise, acceleration at the time of the acceleration and deceleration of a stage is made small.

[0030] Since it becomes impossible to suppress generation of heat from a linear motor when it goes up more than the set point which has the temperature of ********** and linear motor cooling water below in the set point with the flow rate of linear motor cooling water only by making small acceleration at the time of stage acceleration and deceleration, it changes into the state where the drive of a stage was forbidden. It is because the air temperature around a stage will rise and the measurement error of a laser interferometer not only occurs, but it will lead to damage on a linear motor, if generation of heat from a linear motor is not suppressed.

[0031] Thus, it can respond by stopping calorific value by making stage acceleration small and making linear motor current small to reduction of some amounts of circulating water flows, or the rise of a circulating water temperature.

[0032] Moreover, the cooling water setting temperature of a chiller 2 is calculated from the circulating-water-temperature information 16 acquired from the stage circulating-water-temperature detection means 15, and the cooling water setting temperature instructions 17 are outputted to a chiller 2. Since it becomes possible to suppress generation of heat from a linear motor by reducing the cooling water setting temperature of a chiller 2 further, acceleration at the time of stage acceleration and deceleration is made small and it can respond when it becomes impossible to suppress generation of heat from a linear motor by this only by making small acceleration at the time of stage acceleration and deceleration,

an equipment operating ratio rises conventionally.
[0033] The example of the device manufacture method of having used the <example of the device manufacture method>, next the aligner which gave [above-mentioned] explanation is explained. Drawing 6 shows the flow of manufacture of minute devices (semiconductor chips, such as IC and LSI, a liquid crystal panel, CCD, the thin film magnetic head, micro machine, etc.). The pattern design of a device is performed at Step 1 (circuit design). The mask in which the designed pattern was formed is manufactured at Step 2 (mask manufacture). On the other hand, at Step 3 (wafer manufacture), a wafer is manufactured using material, such as silicon and glass. Step 4 (wafer process) is called last process, and forms an actual circuit on a wafer with lithography technology using the mask and wafer which carried out [above-mentioned] preparation. The following step 5 (assembly) is called back process, is a process semiconductor-chip-ized using the wafer produced by Step 4, and includes processes, such as an assembly process (dicing, bonding) and a packaging process (chip enclosure). At Step 6 (inspection), the check test of the semiconductor device produced at Step 5 of operation, an endurance test, etc. are inspected. Through such a process, a semiconductor device is completed and this is shipped (Step 7).
[0034] Drawing 7 shows the detailed flow of the above-mentioned wafer process (Step 4). The front face of a wafer is oxidized at Step 11 (oxidization). An insulator layer is formed in a wafer front face at Step 12 (CVD). At Step 13 (electrode formation), an electrode is formed by vacuum evaporationo on a wafer. Ion is driven into a wafer at Step 14 (ion implantation). A resist is applied to a wafer at Step 15 (resist processing). At Step 16 (exposure), by the aligner or the exposure method which gave [above-mentioned] explanation, the circuit pattern of a mask is arranged in two or more shot fields of a wafer, and printing exposure is carried out. The exposed wafer is developed at Step 17 (development). At Step 18 (etching), portions other than the developed resist image are shaved off. The resist which etching could be managed with Step 19 (resist exfoliation), and became unnecessary is removed. By carrying out by repeating these steps, a circuit pattern is formed on a wafer multiplex.
[0035] If the process of this example is used, the large-sized device for which manufacture was difficult can be conventionally manufactured to a low cost.
[0036]
[Effect of the Invention] Even when a cooling situation gets worse by the fall of the flow rate of a certain amount of cooling water etc. according to this invention since the drive of an actuator was controlled based on the cooling situation of an actuator as explained above, generation of heat of an actuator can be suppressed by suppressing the acceleration by the actuator etc. Therefore, the operating ratio of equipment can be raised.
[0037] Moreover, with a chisel, such as suppressing the acceleration by the actuator, since the cooling situation of an actuator was controlled based on the detection result of the cooling situation of an actuator, even when generation of heat of an actuator cannot be suppressed, in addition to suppression of the acceleration of an actuator, generation of heat of an actuator can be suppressed by lowering the setting temperature of cooling water etc. Therefore, improvement in the depressor effect of generation of heat of an actuator can be aimed at, and the operating ratio of equipment can be raised further.
[0038] Moreover, recovery of a substrate etc. can be performed, without stopping the drive of a stage, if the flow rate and/or temperature of cooling water to a stage are in tolerance, even when the flow rates and/or temperature of cooling water to units other than a stage are abnormalities, in order to make the drive of a stage independently into permission and a prohibition state with other portions based on the flow rate and/or temperature of cooling water to the actuator of a stage. Therefore, the availability of equipment can be raised.
[0039] Moreover, since the acceleration of a stage was controlled based on the flow rate to the actuator of a stage, and/or the detection result of temperature, it can respond by lowering the acceleration at the time of the acceleration and deceleration of a stage, and reducing generation of heat of an actuator to the fall of the flow rate of a certain amount of cooling water, and/or temperature. Therefore, the operating ratio of equipment can be made to raise.
[0040] Moreover, the overrun of a stage can be prevented even when abnormalities occur to the flow rate and temperature of cooling water while the stage is driving, in order to make the drive of a stage

into a prohibition state since a stage is decelerated with the same acceleration as the time of acceleration and was stopped, when making the drive of a stage into a prohibition state, while the stage is driving.

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TECHNICAL FIELD

[The technical field to which invention belongs] this invention relates to the device manufacture method that the aligner and this which use cooling water etc. for cooling of the actuators for a stage drive etc. can be used.

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PRIOR ART

[Description of the Prior Art] Drawing 5 shows the composition about the stage drive system of the conventional semiconductor aligner, and cooling. In the machine room 1 of a semiconductor aligner, the chiller 2, the amount detection means 3 of circulating water flows, and the cooling water distributor 4 are constituted. In the control unit 5 of a semiconductor aligner, the main part power control machine 8 of equipment is constituted with the stage drive controller 6 and the driver 7 for a stage drive. The stage unit 10 is constituted in the main part 9 of a semiconductor aligner.
[0003] A chiller 2 cools the warmed cooling water which has returned from each unit in a main part 9, and makes the cooling water of constant temperature again. The amount detection means 3 of circulating water flows always detects the flow rate of cooling water, and if it becomes below the set point with a flow rate, it will send the amount of circulating water flows unusual signal 11 to the main part power control machine 8 of equipment in the control rack 5. The cooling water distributor 4 arranges the cooling water which comes from the amount detection means 3 of circulating water flows by each YUNITTOHE in a main part 9. The stage drive controller 6 is a controller for carrying out drive control of the stage unit 10. The driver 7 for a stage drive supplies the current into which the current instructions 12 were inputted from the stage drive controller 6 and which was ordered from it to each linear motor in the stage unit 10 (X, YL, YR), and drives a stage. The main part power control machine 8 of equipment turns off the main part power supply of equipment, if the amount of circulating water flows unusual signal from the amount detection means 3 of circulating water flows is inputted.

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EFFECT OF THE INVENTION

[Effect of the Invention] Even when a cooling situation gets worse by the fall of the flow rate of a certain amount of cooling water etc. according to this invention since the drive of an actuator was controlled based on the cooling situation of an actuator as explained above, generation of heat of an actuator can be suppressed by suppressing the acceleration by the actuator etc. Therefore, the operating ratio of equipment can be raised.
[0037] Moreover, with a chisel, such as suppressing the acceleration by the actuator, since the cooling situation of an actuator was controlled based on the detection result of the cooling situation of an actuator, even when generation of heat of an actuator cannot be suppressed, in addition to suppression of the acceleration of an actuator, generation of heat of an actuator can be suppressed by lowering the setting temperature of cooling water etc. Therefore, improvement in the depressor effect of generation of heat of an actuator can be aimed at, and the operating ratio of equipment can be raised further.
[0038] Moreover, recovery of a substrate etc. can be performed, without stopping the drive of a stage, if the flow rate and/or temperature of cooling water to a stage are in tolerance, even when the flow rates and/or temperature of cooling water to units other than a stage are abnormalities, in order to make the drive of a stage independently into permission and a prohibition state with other portions based on the flow rate and/or temperature of cooling water to the actuator of a stage. Therefore, the availability of equipment can be raised.
[0039] Moreover, since the acceleration of a stage was controlled based on the flow rate to the actuator of a stage, and/or the detection result of temperature, it can respond by lowering the acceleration at the time of the acceleration and deceleration of a stage, and reducing generation of heat of an actuator to the fall of the flow rate of a certain amount of cooling water, and/or temperature. Therefore, the operating ratio of equipment can be made to raise.
[0040] Moreover, the overrun of a stage can be prevented even when abnormalities occur to the flow rate and temperature of cooling water while the stage is driving, in order to make the drive of a stage into a prohibition state since a stage is decelerated with the same acceleration as the time of acceleration and was stopped, when making the drive of a stage into a prohibition state, while the stage is driving.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, in the above-mentioned conventional example, when the amounts of circulating water flows of units other than stage unit 10 are abnormalities, although the amount of circulating water flows of stage unit 10 HE is normal, the amount of circulating water flows unusual signal occurs from the amount detection means 3 of circulating water flows, and the main part power supply of equipment is set to being turned off. Consequently, the power supply of a stage drive system may also be set to being turned off, and recovery of a wafer etc. may become impossible. Thereby, there is a fault that the availability of equipment will fall.
[0005] Moreover, if the amount of circulating water flows unusual signal occurs while the stage is driving by constant speed, since the power supply of a stage drive system is also turned off, a stage cannot be slowed down and there is a fault that there is a possibility that a stage may overrun recklessly.
[0006] In view of the trouble of such conventional technology, in an aligner and the device manufacture method, even when the flow rates of cooling water other than a stage are abnormalities, the 1st purpose of this invention avoids the situation of recovery of a wafer etc. becoming impossible, and is to raise equipment availability by this.
[0007] The 2nd purpose of this invention is to raise an equipment operating ratio also to the fall of the flow rate of a certain amount of cooling water, as it can respond to generation of heat of an actuator.
[0008] The 3rd purpose of this invention is to make it the overrun of a stage not take place, even if the flow rate of cooling water becomes unusual, while the stage is driving by constant speed.

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MEANS

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the aligner of this invention is characterized by providing a cooling situation detection means to detect the cooling situation of the actuator which equipment has, and the drive control means which control the drive of an actuator based on the detection result of a cooling situation.
[0010] Moreover, the device manufacture method of this invention is characterized by manufacturing a device by exposing using such an aligner, controlling the drive of an actuator based on the cooling situation of the actuator.
[0011] According to this, even when a cooling situation gets worse by the fall of the flow rate of a certain amount of cooling water etc., generation of heat of an actuator is suppressed by suppressing the driving force of an actuator etc.
[0012] Moreover, the aligner concerning another form of this invention is characterized by providing a cooling situation detection means to detect the cooling situation of the actuator which equipment has, and a cooling situational-control means to control the cooling situation of the aforementioned actuator based on the detection result of the aforementioned cooling situation. A cooling situational-control means controls the cooling situation of an actuator by determining the temperature of the cooling water to an actuator, and changing.
[0013] According to this, with a chisel, such as suppressing the driving force of an actuator, even when generation of heat of an actuator cannot be suppressed, in addition to suppression of the driving force of an actuator, generation of heat of an actuator is suppressed by lowering the setting temperature of cooling water etc., and improvement in the depressor effect of generation of heat of an actuator is achieved.
[0014]
[Embodiments of the Invention] In the desirable operation form of this invention, an actuator is an actuator which drives the stage for positioning the substrate by which the negative or exposure pattern which has an exposure pattern is exposed, and is cooled with cooling water. A cooling situation detection means detects the flow rate and/or temperature of cooling water to an actuator. Drive control means make the drive of a stage permission and a prohibition state independently with other portions based on the detection result of the aforementioned flow rate and/or temperature. If the flow rate and/or temperature of cooling water to a stage are in tolerance even when the flow rates and/or temperature of cooling water to units other than a stage are abnormalities according to this, since the drive of a stage can perform recovery of a substrate etc., without stopping, improvement in equipment availability will be achieved.
[0015] Moreover, drive control means control the acceleration of the aforementioned stage based on the detection result of the flow rate by the aforementioned cooling situation detection means, and/or temperature. According to this, it can respond by lowering the acceleration at the time of the acceleration and deceleration of a stage, and reducing generation of heat of an actuator to the fall of the flow rate of a certain amount of cooling water, and/or temperature. Therefore, it leads to the rise of an equipment operating ratio.

[0016] Moreover, since drive control means decelerate a stage with the same acceleration as the time of acceleration and stop it when making the drive of a stage into a prohibition state, while the stage is driving, they make the drive of a stage a prohibition state. The overrun of a stage is prevented, even when abnormalities occur to the flow rate and temperature of cooling water according to this, while the stage is driving.

[Translation done.]

* NOTICES *

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EXAMPLE

[Example]

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram showing the aligner concerning the 1st example of this invention.
[Drawing 2] It is a graph for explaining the 2nd example of this invention.
[Drawing 3] It is a flow chart for explaining the 3rd example of this invention.
[Drawing 4] It is the block diagram showing the aligner concerning the 4th example of this invention.
[Drawing 5] It is the block diagram showing the aligner concerning the conventional example.
[Drawing 6] It is the flow chart which shows the device manufacture method that the aligner of this invention can be used.
[Drawing 7] It is the detailed flow chart of the wafer process in drawing 6 .
[Description of Notations]
Machine room, 2:chiller, the amount detection means of 3:circulating water flows, 4 : 1: A cooling water distributor, 5 : A control unit, 6:stage drive controller, the driver for 7:stage drive, 8: The main part power control machine of equipment, 9:main part, 10:stage unit, 11 : The amount of circulating water flows unusual signal, 12: Current instructions, the amount detector of 13:stage circulating water flows, the amount information of 14:stage circulating water flows, 15:stage circulating-water-temperature detector, 16:stage circulating-water-temperature information, 17: Cooling water setting temperature instructions.

[Translation done.]

* NOTICES *

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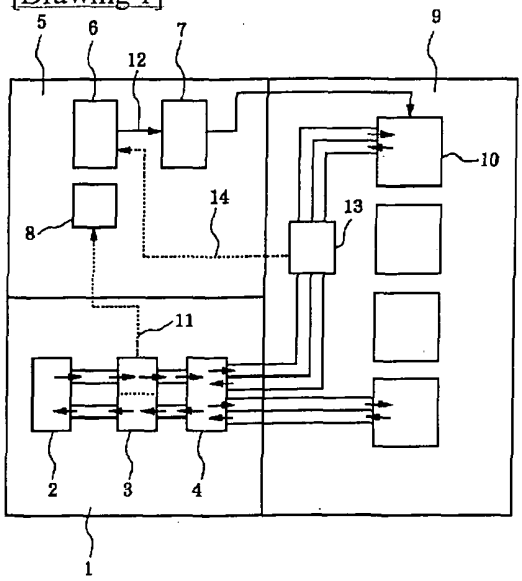
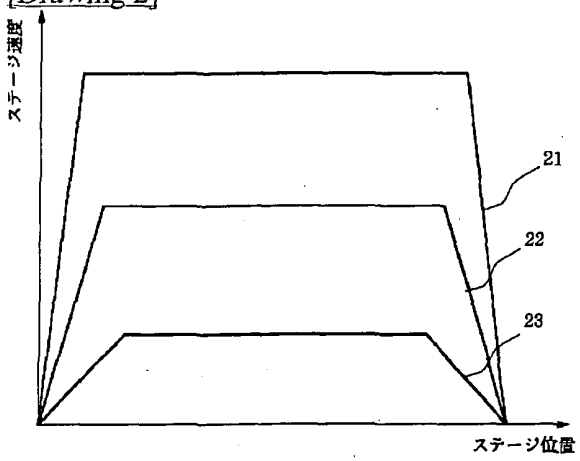
DRAWINGS

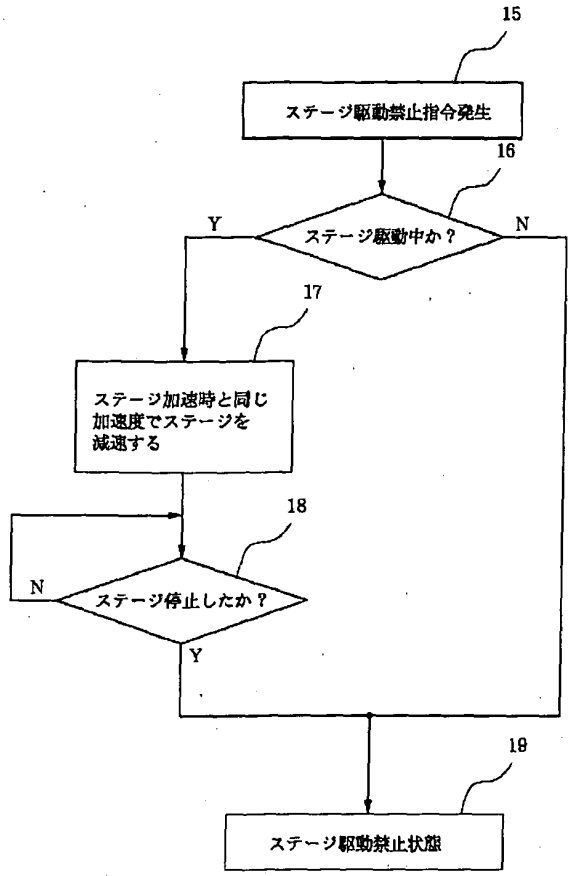
[Drawing 1]



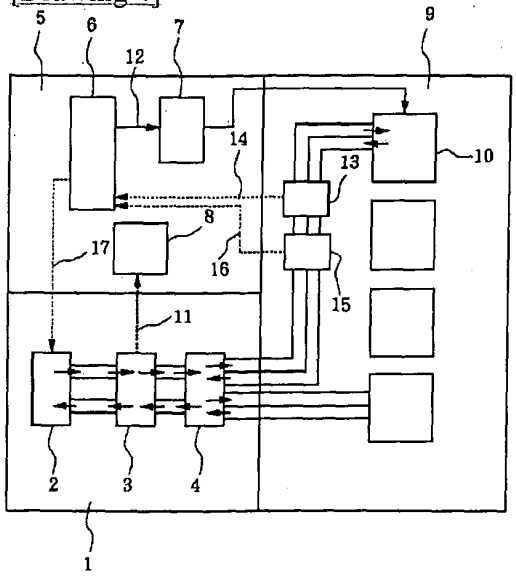
[Drawing 2]



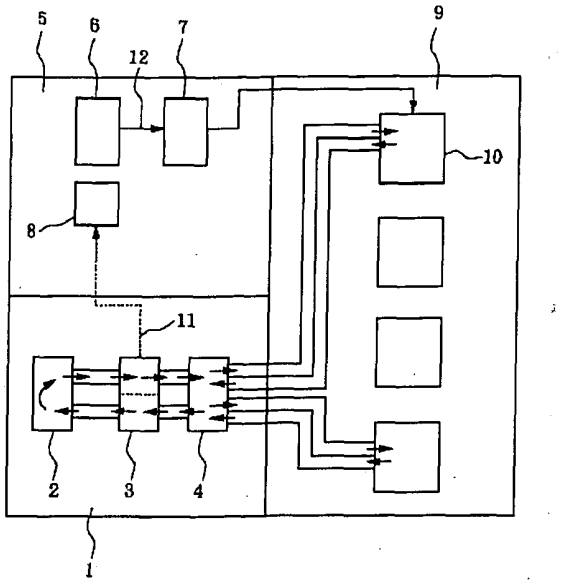
[Drawing 3]



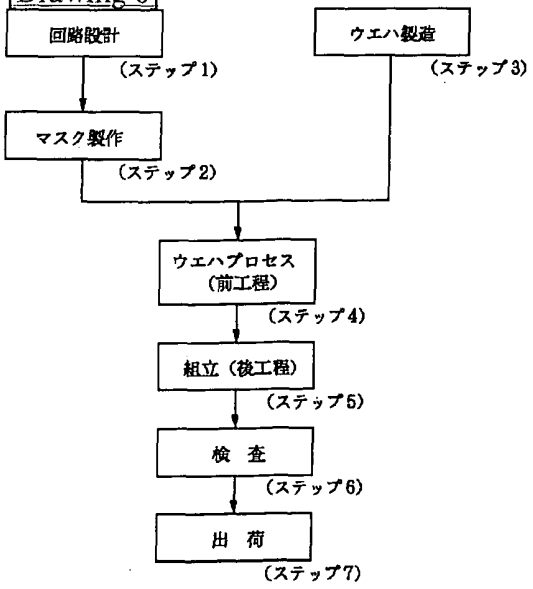
[Drawing 4]



[Drawing 5]

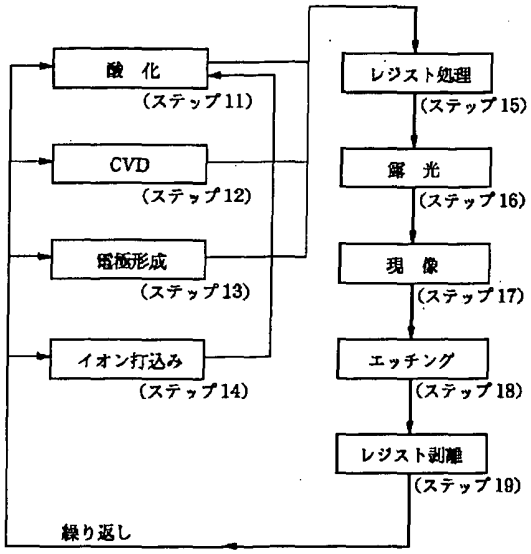


[Drawing 6]



半導体デバイス製造フロー

[Drawing 7]



ウエハプロセス

[Translation done.]

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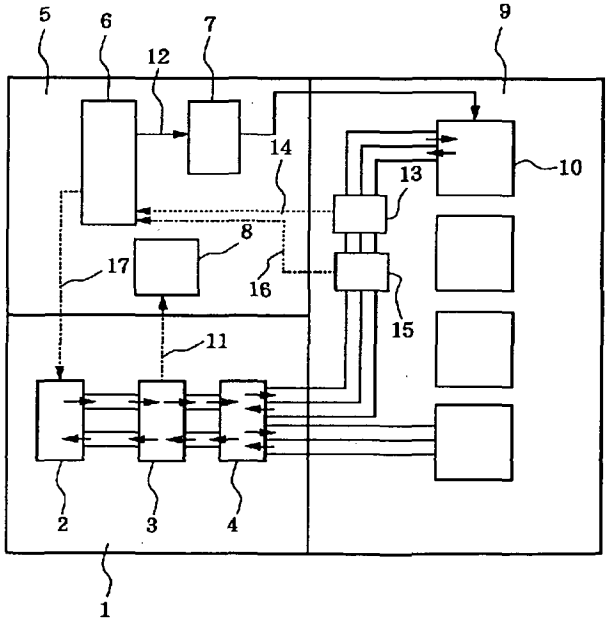
(54)【発明の名称】　露光装置およびデバイス製造方法

(57)【要約】
【課題】　ステージ以外への冷却水の流量が異常の場合でも基板の回収等ができなくなるという事態を回避する。また、ある程度冷却水の流量が低下してもアクチュエータの発熱に対応できるようにする。さらに、ステージが駆動している時に冷却水の流量等が異常となってもステージの暴走が起らないようにする。
【解決手段】　装置のアクチュエータの冷却状況を検出する冷却状況検出手段１３、１５と、冷却状況の検出結果に基づいてアクチュエータの駆動を制御する駆動制御手段５を設ける。冷却状況検出手段はステージ１０のアクチュエータへの冷却水の流量および／または温度を検出し、駆動制御手段はこの検出結果に基づいてステージの駆動を独立して許容および禁止状態とし、またステージの加速度を制御し、さらには、ステージが駆動している時にステージの駆動を禁止状態とする場合、所定の減速を行ってからステージの駆動を禁止状態とする。さらに、冷却状況の検出結果に基づいてアクチュエータの冷却状況を制御する。



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【特許請求の範囲】

【請求項１】　装置が有するアクチュエータの冷却状況を検出する冷却状況検出手段と、前記冷却状況の検出結果に基づいて前記アクチュエータの駆動を制御する駆動制御手段とを具備することを特徴とする露光装置。

【請求項２】　前記アクチュエータは、露光パターンを有する原板または前記露光パターンが露光される基板を位置決めするためのステージを駆動するアクチュエータであって冷却水により冷却されるものであり、前記冷却状況検出手段は前記アクチュエータへの冷却水の流量を検出するものであり、前記駆動制御手段は前記流量の検出結果に基づいて前記ステージの駆動を他の部分とは独立して許容および禁止状態とするものであることを特徴とする請求項１に記載の露光装置。

【請求項３】　前記アクチュエータは、露光パターンを有する原板または前記露光パターンが露光される基板を位置決めするためのステージを駆動するアクチュエータであって冷却水により冷却されるものであり、前記冷却状況検出手段は前記アクチュエータへの冷却水の温度を検出するものであり、前記駆動制御手段は前記温度の検出結果に基づいて前記ステージの駆動を他の部分とは独立して許容および禁止状態とするものであることを特徴とする請求項１に記載の露光装置。

【請求項４】　前記アクチュエータは、露光パターンを有する原板または前記露光パターンが露光される基板を位置決めするためのステージを駆動するアクチュエータであって冷却水により冷却されるものであり、前記冷却状況検出手段は前記アクチュエータへの冷却水の流量および温度を検出するものであり、前記駆動制御手段は前記流量および温度の検出結果に基づいて前記ステージの駆動を他の部分とは独立して許容および禁止状態とするものであることを特徴とする請求項１に記載の露光装置。

【請求項５】　前記アクチュエータは、露光パターンを有する原板または前記露光パターンが露光される基板を位置決めするためのステージを駆動するアクチュエータであって冷却水により冷却されるものであり、前記冷却状況検出手段は前記アクチュエータへの冷却水の流量を検出するものであり、前記駆動制御手段は前記流量の検出結果に基づいて前記ステージの加速度を制御するものであることを特徴とする請求項１に記載の露光装置。

【請求項６】　前記アクチュエータは、露光パターンを有する原板または前記露光パターンが露光される基板を位置決めするためのステージを駆動するアクチュエータであって冷却水により冷却されるものであり、前記冷却状況検出手段は前記アクチュエータへの冷却水の温度を検出するものであり、前記駆動制御手段は前記温度の検出結果に基づいて前記ステージの加速度を制御するものであることを特徴とする請求項１に記載の露光装置。

【請求項７】　前記アクチュエータは、露光パターンを有する原板または前記露光パターンが露光される基板を位置決めするためのステージを駆動するアクチュエータであって冷却水により冷却されるものであり、前記冷却状況検出手段は前記アクチュエータへの冷却水の流量および温度を検出するものであり、前記駆動制御手段は前記流量および温度の検出結果に基づいて前記ステージの加速度を制御するものであることを特徴とする請求項１に記載の露光装置。

【請求項８】　前記駆動制御手段は、前記ステージが駆動している時に前記ステージの駆動を禁止状態とする場合、前記ステージを加速時と同じ加速度で減速させて停止させてから前記ステージの駆動を禁止状態とするものであることを特徴とする請求項２～４のいずれか１項に記載の露光装置。

【請求項９】　装置が有するアクチュエータの冷却状況を検出する冷却状況検出手段と、前記冷却状況の検出結果に基づいて前記アクチュエータの冷却状況を制御する冷却状況制御手段とを具備することを特徴とする露光装置。

【請求項１０】　前記アクチュエータは、露光パターンを有する原板または前記露光パターンが露光される基板を位置決めするためのステージを駆動するアクチュエータであって冷却水により冷却されるものであり、前記冷却状況検出手段は前記アクチュエータへの冷却水の流量または温度を検出するものであり、前記冷却状況制御手段は前記アクチュエータへの冷却水の温度を決定しおよび変更するものであることを特徴とする請求項９に記載の露光装置。

【請求項１１】　露光装置を用い、そのアクチュエータの冷却状況に基づいて前記アクチュエータの駆動を制御しながら露光を行うことによりデバイスを製造することを特徴とするデバイス製造方法。

【請求項１２】　前記アクチュエータの冷却状況に基づいて前記アクチュエータの冷却状況を制御しながら露光を行うことによりデバイスを製造することを特徴とする請求項１１に記載のデバイス製造方法。

【請求項１３】　前記アクチュエータは、露光パターンを有する原板または前記露光パターンが露光される基板を位置決めするためのステージを駆動するアクチュエータであって冷却水により冷却されるものであり、前記冷却状況は、前記冷却水の流量または温度の状況であり、前記アクチュエータの駆動の制御に際しては、前記ステージの駆動を他の部分とは独立に許容および禁止し、または加速度を指定することを特徴とする請求項１１または１２に記載のデバイス製造方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、ステージ駆動用等のアクチュエータの冷却に冷却水等を使っている露光装置およびこれを用いることができるデバイス製造方法に

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関する。

【０００２】

【従来の技術】図５は、従来の半導体露光装置のステージ駆動系と冷却に関する構成を示す。半導体露光装置の機械室１内には、チラー２と、冷却水流量検出手段３と、冷却水分配器４が構成されている。半導体露光装置の制御装置５内には、ステージ駆動制御器６と、ステージ駆動用ドライバ７と、装置本体電源制御器８が構成されている。半導体露光装置の本体９内には、ステージユニット１０が構成されている。

【０００３】チラー２は本体９内の各ユニットから戻ってきた暖められた冷却水を冷やし、再び一定温度の冷却水を作る。冷却水流量検出手段３は、常に冷却水の流量を検出し、流量がある設定値以下になると制御ラック５内の装置本体電源制御器８へ冷却水流量異常信号１１を送る。冷却水分配器４は、冷却水流量検出手段３から来る冷却水を本体９内にある各ユニットへ分配する。ステージ駆動制御器６は、ステージユニット１０を駆動制御するための制御器である。ステージ駆動用ドライバ７は、ステージ駆動制御器６から電流指令１２が入力され、指令された電流をステージユニット１０内の各リニアモータ（Ｘ、ＹＬ、ＹＲ）へ供給し、ステージを駆動する。装置本体電源制御器８は、冷却水流量検出手段３からの冷却水流量異常信号が入力されると、装置本体電源をＯＦＦするようになっている。

【０００４】

【発明が解決しようとする課題】しかしながら、上記従来例では、ステージユニット１０以外のユニットの冷却水流量が異常の場合、ステージユニット１０への冷却水流量は正常であるにもかかわらず、冷却水流量検出手段３から冷却水流量異常信号が発生し、装置本体電源がＯＦＦとなる。その結果、ステージ駆動系の電源もＯＦＦとなり、ウエハの回収等ができなくなってしまう可能性がある。これにより、装置の稼動率が低下してしまうという欠点がある。

【０００５】また、ステージが一定速度で駆動している時に冷却水流量異常信号が発生すると、ステージ駆動系の電源もＯＦＦしてしまうため、ステージの減速が行えず、ステージが暴走する恐れがあるという欠点がある。

【０００６】このような従来技術の問題点に鑑み、本発明の第１の目的は、露光装置およびデバイス製造方法において、ステージ以外への冷却水の流量が異常の場合でも、ウエハの回収等ができなくなるという事態を回避し、これにより装置稼動率を向上させることにある。

【０００７】本発明の第２の目的は、ある程度の冷却水の流量の低下に対しても、アクチュエータの発熱に対応できるようにして、装置稼働率を向上させることにある。

【０００８】本発明の第３の目的は、ステージが一定速度で駆動している時に冷却水の流量が異常となっても、ステージの暴走が起らないようにすることにある。

【０００９】

【課題を解決するための手段】上記目的を達成するため、本発明の露光装置は、装置が有するアクチュエータの冷却状況を検出する冷却状況検出手段と、冷却状況の検出結果に基づいてアクチュエータの駆動を制御する駆動制御手段とを具備することを特徴とする。

【００１０】また、本発明のデバイス製造方法は、このような露光装置を用い、そのアクチュエータの冷却状況に基づいてアクチュエータの駆動を制御しながら露光を行うことによりデバイスを製造することを特徴とする。

【００１１】これによれば、ある程度の冷却水の流量の低下等により冷却状況が悪化した場合でも、アクチュエータの駆動力を抑制する等により、アクチュエータの発熱が抑制される。

【００１２】また、本発明の別の形態に係る露光装置は、装置が有するアクチュエータの冷却状況を検出する冷却状況検出手段と、前記冷却状況の検出結果に基づいて前記アクチュエータの冷却状況を制御する冷却状況制御手段とを具備することを特徴とする。冷却状況制御手段は、たとえばアクチュエータへの冷却水の温度を決定しおよび変更することによりアクチュエータの冷却状況を制御する。

【００１３】これによれば、アクチュエータの駆動力を抑制する等のみではアクチュエータの発熱が抑制できないような場合でも、アクチュエータの駆動力の抑制に加え、冷却水の設定温度を下げる等によりアクチュエータの発熱が抑制され、アクチュエータの発熱の抑制効果の向上が図られる。

【００１４】

【発明の実施の形態】本発明の好ましい実施形態においては、アクチュエータは、露光パターンを有する原板または露光パターンが露光される基板を位置決めするためのステージを駆動するアクチュエータであって冷却水により冷却される。冷却状況検出手段はアクチュエータへの冷却水の流量および／または温度を検出する。駆動制御手段は前記流量および／または温度の検出結果に基づいてステージの駆動を他の部分とは独立して許容および禁止状態とする。これによれば、ステージ以外のユニットへの冷却水の流量および／または温度が異常の場合でも、ステージへの冷却水の流量および／または温度が許容範囲にあれば、ステージの駆動は停止することなく、基板の回収等ができるため、装置稼動率の向上が図られる。

【００１５】また、駆動制御手段は前記冷却状況検出手段による流量および／または温度の検出結果に基づいて前記ステージの加速度を制御する。これによれば、ある程度の冷却水の流量および／または温度の低下に対しては、ステージの加減速時の加速度を下げてアクチュエータの発熱を低下させることにより対応することができ

る。したがって、装置稼働率のアップにつながる。

【００１６】また、駆動制御手段は、ステージが駆動している時にステージの駆動を禁止状態とする場合、ステージを加速時と同じ加速度で減速させて停止させてからステージの駆動を禁止状態とする。これによれば、ステージが駆動している時に冷却水の流量や温度に異常が発生した場合でも、ステージの暴走が防止される。

【００１７】

【実施例】（第１の実施例）図１は本発明の第１の実施例に係る露光装置を示す図であって、本発明の特徴を最もよく表す図である。同図において、１～１２は図５の従来例の場合と同様の要素を指し示す。１３はステージユニット１０のステージ駆動用リニアモータ冷却用のステージ冷却水流量を検出するステージ冷却水流量検出手段であり、１４はステージ冷却水流量検出手段１３からステージ駆動制御器６へ送られるステージ冷却水流量情報である。

【００１８】上記構成において、ステージ冷却水流量検出手段１３は、冷却水分配器４からステージユニット１０用に分配されたステージ駆動用リニアモータの冷却水の流量を検出する。検出したステージ冷却水流量情報１４はステージ駆動制御器６へ送られる。ステージ駆動制御器６は、ステージ冷却水流量情報１４に基づき、ステージユニット１０への冷却水の流量が正常であれば、ステージユニット１０の駆動を停止させない。これにより、ステージユニット１０以外のユニットの冷却水流量が異常の場合でも、ステージユニット１０への冷却水の流量が正常であれば、ステージユニット１０の駆動は停止しないため、ウエハの回収等を正常に完了することでき、装置の稼動率を向上させることができる。

【００１９】（第２の実施例）図２は本発明の第２の実施例を説明する図であり、ステージ冷却水流量検出手段１３により得られる冷却水流量値からステージユニット１０におけるステージ駆動の加減速の加速度を決定するステージ加速度決定手段を説明する図である。装置全体のブロック図は、第１の実施例の場合と同じ図１である。このステージ加速度決定手段はステージ駆動制御器６の中に存在する。

【００２０】図２において、２１はステージユニット１０におけるステージのリニアモータへの冷却水流量が通常の場合のステージ駆動パターンを示すラインであり、２２はステージのリニアモータ冷却水流量が通常の例えば９０％しかない場合のステージ駆動パターンを示すラインである。このように、リニアモータ冷却水流量が通常の９０％しかない場合は、リニアモータ冷却水流量が１０％減少した分、リニアモータからの発熱を抑えるために、ステージの加減速時の加速度を小さくする。

【００２１】２３はステージのリニアモータ冷却水流量が通常の例えば８０％しかない場合のステージ駆動パターンを示す。この場合は、リニアモータ冷却水流量が２０％減少した分、リニアモータからの発熱を抑えるために、ステージの加減速時の加速度をライン２２の場合よりさらに小さくする。

【００２２】リニアモータ冷却水流量が通常の例えば７０％以下になった場合は、ステージ加減速時の加速度を小さくすることによってはリニアモータからの発熱を抑えることができなくなるため、ステージを駆動禁止の状態にする。リニアモータからの発熱を冷却しないでそのままにすると、ステージ周辺の空気温度が上昇し、レーザ干渉計の計測誤差が発生するばかりでなく、リニアモータの損傷につながるからである。

【００２３】これにより、多少の冷却水流量減少に対しては、リニアモータからの発熱量を小さくすることにより対応できるので、従来より装置稼働率がアップする。

【００２４】（第３の実施例）図３は本発明の第３の実施例を説明する図であり、第２の実施例で示したように、ステージが一定速度で駆動している時にステージ駆動禁止状態とする場合において、ステージ駆動加速時と同じ加速度でステージを減速させ、ステージを停止させてから前記ステージ駆動禁止状態を有効とするステージ緊急停止手段の動作を示すフローチャートである。装置全体のブロック図は、第１の実施例と同じ図１である。このステージ緊急停止手段は、ステージ駆動制御器６の中に存在する。

【００２５】ステージ冷却水流量が通常の例えば７０％以下になって、ステージ加減速時の加速度を調整するだけでは対応することができなくなるために、ステージ駆動禁止指令信号が発生すと（ステップ１５）、現在、ステージが駆動中か停止中かを判断し（ステップ１６）、ステージが停止中ならばそのままステージ駆動禁止状態に入る（ステップ１９）。もしステージが駆動中ならば、ステージ加速時と同じ加速度でステージを減速させ、ステージを停止させる（ステップ１７）。そして、ステージが停止したかどうか判断し（ステップ１８）、もしステージが停止していなければ、停止するまで待つ。ステージが停止したならば、ステージ駆動禁止状態に入り（ステップ１９）、ステージ冷却水流量が正常になって駆動禁止状態が解除されるまで、ステージが駆動できないように動作する。これにより、ステージが一定速度で駆動している時に冷却水流量異常信号が発生しても、ステージの暴走を防止することができる。

【００２６】（第４の実施例）図４は本発明の第４の実施例に係る半導体露光装置の全体の構成を示すブロック図である。同図において、１～１４は第１の実施例の場合と同様である。１５はステージユニット１０におけるステージ駆動用リニアモータ冷却用のステージ冷却水温度を検出するステージ冷却水温度検出手段であり、１６はステージ冷却水温度検出手段１５からステージ駆動制御器６へ送られるステージ冷却水温度の情報であり、１７はステージ駆動制御器６からチラー２へ送られる冷却

水設定温度指令である。

【００２７】上記構成において、ステージ冷却水流量検出手段１３は、冷却水分配器４からステージユニット１０用に分配されたステージ駆動用リニアモータの冷却水の流量を検出する。検出したステージ冷却水流量の情報１４はステージ駆動制御器６へ送られる。ステージ冷却水温度検出手段１５は、冷却水分配器４からステージユニット１０用に分配されたステージ駆動用リニアモータの冷却水の温度を検出する。検出したステージ冷却水温度の情報１６はステージ駆動制御器６へ送られる。

【００２８】ステージ冷却水流量検出手段１３より得られたステージ冷却水流量情報１４とステージ冷却水温度検出手段１５より得られたステージ冷却水温度情報１６からステージ駆動の加減速の加速度を決定する。この決定を行うステージ加速度決定手段はステージ駆動制御器６の中に存在する。

【００２９】ステージ加速度決定手段は、リニアモータ冷却水の流量が減少した場合、流量が減少した分の冷却能力低下に相当するリニアモータの発熱を抑えるために、ステージの加減速時の加速度を小さくする。また、リニアモータ冷却水の温度が上昇した場合、温度上昇した分の冷却能力低下に相当するリニアモータの発熱を抑えるために、ステージの加減速時の加速度を小さくする。

【００３０】リニアモータ冷却水の流量がある設定値以下に減少したり、リニアモータ冷却水の温度がある設定値以上に上昇した場合は、ステージ加減速時の加速度を小さくするだけではリニアモータからの発熱を抑えることができなくなるため、ステージの駆動を禁止した状態にする。リニアモータからの発熱を抑えないと、ステージ周辺の空気温度が上昇し、レーザ干渉計の計測誤差が発生するばかりでなく、リニアモータの損傷につながるからである。

【００３１】このようにして、多少の冷却水流量の減少や冷却水温度の上昇に対しては、ステージ加速度を小さくしてリニアモータ電流を小さくすることによって発熱量を抑えることにより対応することができる。

【００３２】また、ステージ冷却水温度検出手段１５より得られた冷却水温度情報１６からチラー２の冷却水設定温度を計算し、チラー２に対し冷却水設定温度指令１７を出力する。これにより、ステージ加減速時の加速度を小さくするだけではリニアモータからの発熱を抑えることができなくなった場合、さらにチラー２の冷却水設定温度を低下させることによってリニアモータからの発熱を抑えることが可能となり、ステージ加減速時の加速度を小さくして対応できるので、従来より装置稼働率がアップする。

【００３３】＜デバイス製造方法の実施例＞次に上記説明した露光装置を利用したデバイス製造方法の実施例を説明する。図６は微小デバイス（ＩＣやＬＳＩ等の半導体チップ、液晶パネル、ＣＣＤ、薄膜磁気ヘッド、マイクロマシン等）の製造のフローを示す。ステップ１（回路設計）ではデバイスのパターン設計を行なう。ステップ２（マスク製作）では設計したパターンを形成したマスクを製作する。一方、ステップ３（ウエハ製造）ではシリコンやガラス等の材料を用いてウエハを製造する。ステップ４（ウエハプロセス）は前工程と呼ばれ、上記用意したマスクとウエハを用いて、リソグラフィ技術によってウエハ上に実際の回路を形成する。次のステップ５（組立て）は後工程と呼ばれ、ステップ４によって作製されたウエハを用いて半導体チップ化する工程であり、アッセンブリ工程（ダイシング、ボンディング）、パッケージング工程（チップ封入）等の工程を含む。ステップ６（検査）ではステップ５で作製された半導体デバイスの動作確認テスト、耐久性テスト等の検査を行なう。こうした工程を経て、半導体デバイスが完成し、これが出荷（ステップ７）される。

【００３４】図７は上記ウエハプロセス（ステップ４）の詳細なフローを示す。ステップ１１（酸化）ではウエハの表面を酸化させる。ステップ１２（ＣＶＤ）ではウエハ表面に絶縁膜を形成する。ステップ１３（電極形成）ではウエハ上に電極を蒸着によって形成する。ステップ１４（イオン打込み）ではウエハにイオンを打ち込む。ステップ１５（レジスト処理）ではウエハにレジストを塗布する。ステップ１６（露光）では上記説明した露光装置または露光方法によってマスクの回路パターンをウエハの複数のショット領域に並べて焼付露光する。ステップ１７（現像）では露光したウエハを現像する。ステップ１８（エッチング）では現像したレジスト像以外の部分を削り取る。ステップ１９（レジスト剥離）ではエッチングが済んで不要となったレジストを取り除く。これらのステップを繰り返し行なうことによって、ウエハ上に多重に回路パターンが形成される。

【００３５】本実施例の生産方法を用いれば、従来は製造が難しかった大型のデバイスを低コストに製造することができる。

【００３６】

【発明の効果】以上説明したように本発明によれば、アクチュエータの冷却状況に基づいてアクチュエータの駆動を制御するようにしたため、ある程度の冷却水の流量の低下等により冷却状況が悪化した場合でも、アクチュエータによる加速度を抑制する等により、アクチュエータの発熱を抑制することができる。したがって、装置の稼働率を向上させることができる。

【００３７】また、アクチュエータの冷却状況の検出結果に基づいてアクチュエータの冷却状況を制御するようにしたため、アクチュエータによる加速度を抑制する等のみではアクチュエータの発熱が抑制できないような場合でも、アクチュエータの加速度の抑制に加え、冷却水の設定温度を下げる等によりアクチュエータの発熱を抑

制することができる。したがって、アクチュエータの発熱の抑制効果の向上を図り、装置の稼働率をさらに向上させることができる。

【００３８】また、ステージのアクチュエータへの冷却水の流量および／または温度に基づいてステージの駆動を他の部分とは独立して許容および禁止状態とするようにしたため、ステージ以外のユニットへの冷却水の流量および／または温度が異常の場合でも、ステージへの冷却水の流量および／または温度が許容範囲にあれば、ステージの駆動を停止させることなく、基板の回収等を行うことができる。したがって、装置の稼動率を向上させることができる。

【００３９】また、ステージのアクチュエータへの流量および／または温度の検出結果に基づいてステージの加速度を制御するようにしたため、ある程度の冷却水の流量および／または温度の低下に対しては、ステージの加減速時の加速度を下げてアクチュエータの発熱を低下させることにより対応することができる。したがって、装置の稼働率をアップさせることができる。

【００４０】また、ステージが駆動している時にステージの駆動を禁止状態とする場合、ステージを加速時と同じ加速度で減速させて停止させてからステージの駆動を禁止状態とするようにしたため、ステージが駆動している時に冷却水の流量や温度に異常が発生した場合でも、ステージの暴走を防止することができる。

【図面の簡単な説明】

【図１】　本発明の第１の実施例に係る露光装置を示すブロック図である。

【図２】　本発明の第２の実施例を説明するためのグラフである。

【図３】　本発明の第３の実施例を説明するためのフローチャートである。

【図４】　本発明の第４の実施例に係る露光装置を示すブロック図である。

【図５】　従来例に係る露光装置を示すブロック図である。

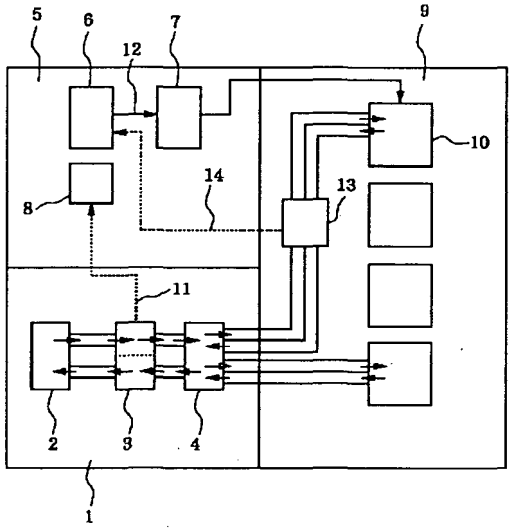
【図６】　本発明の露光装置を利用できるデバイス製造方法を示すフローチャートである。

【図７】　図６中のウエハプロセスの詳細なフローチャートである。

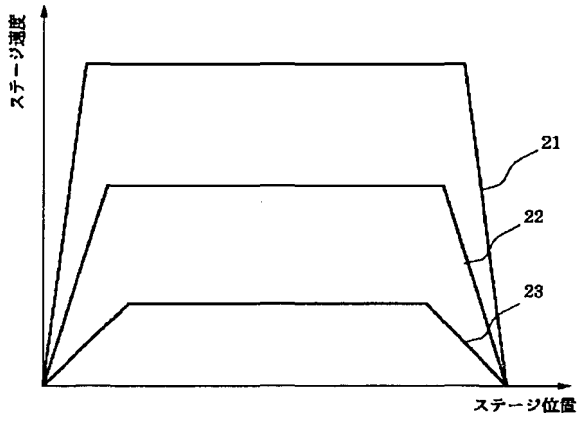
【符号の説明】

１：機械室、２：チラー、３：冷却水流量検出手段、４：冷却水分配器、５：制御装置、６：ステージ駆動制御器、７：ステージ駆動用ドライバ、８：装置本体電源制御器、９：本体、１０：ステージユニット、１１：冷却水流量異常信号、１２：電流指令、１３：ステージ冷却水流量検出器、１４：ステージ冷却水流量情報、１５：ステージ冷却水温度検出器、１６：ステージ冷却水温度情報、１７：冷却水設定温度指令。

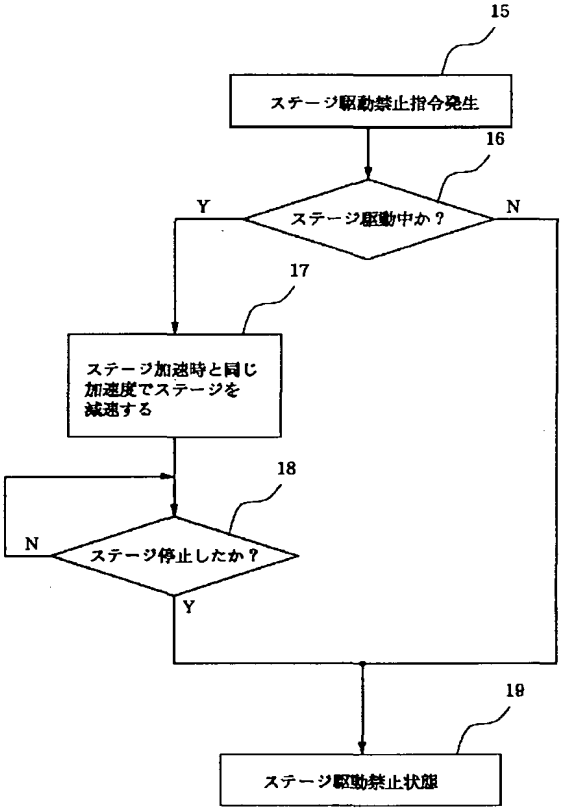
【図１】



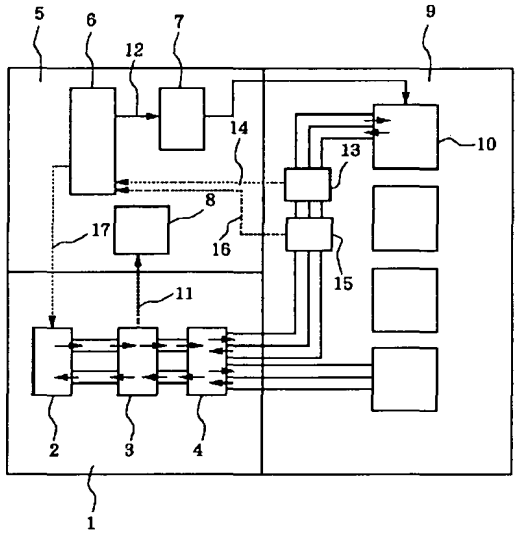
【図２】



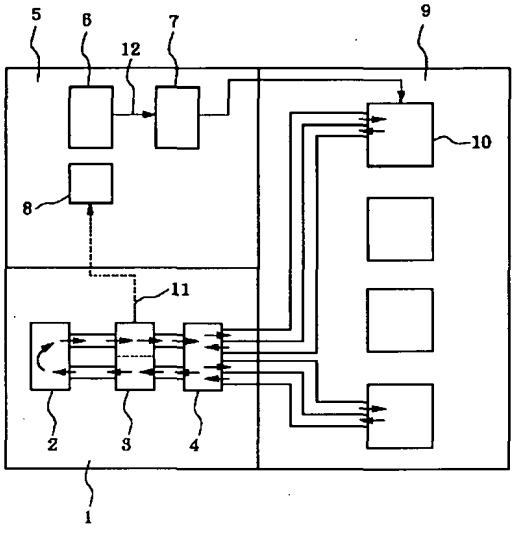
【図３】



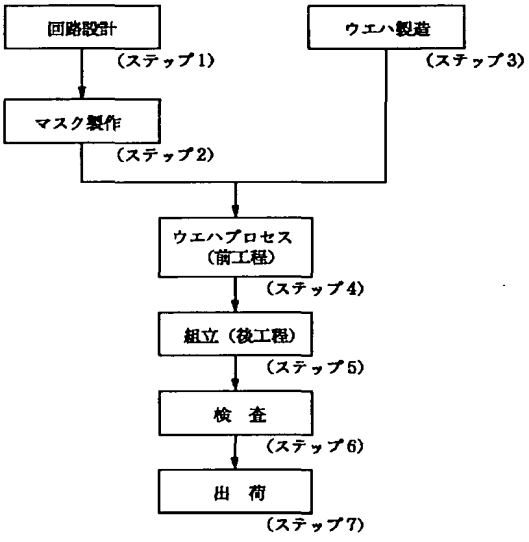
【図４】



【図５】

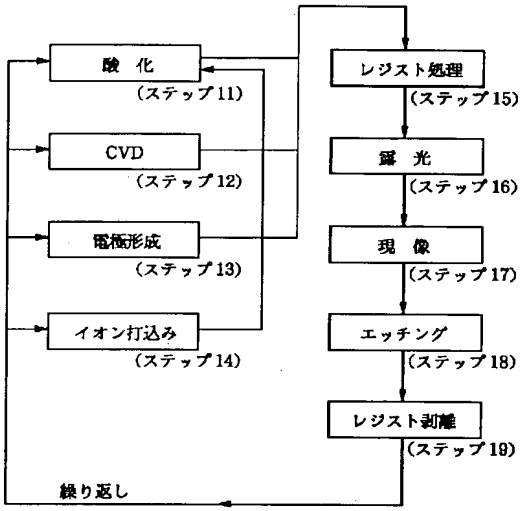


【図６】



半導体デバイス製造フロー

【図７】


酸　化
(ステップ11)
CVD
(ステップ12)
電極形成
(ステップ13)
イオン打込み
(ステップ14)
レジスト処理
(ステップ15)
露　光
(ステップ16)
現　像
(ステップ17)
エッチング
(ステップ18)
レジスト剥離
(ステップ19)
繰り返し

ウエハプロセス